Dawn of a New Space Age: Developing a Global Exploration Strategy

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August 16, 2006

An Aside - Why Are You Here????

- **BE INSPIRED** by the incredible accomplishments of others and the vision of the future that **THEY** describe

- **INSPIRE OTHERS** by the your incredible accomplishments and the vision of the future that **YOU** describe

This Workshop Provides You With An Opportunity to Move From ***Being Inspired*** *-* *To* ***Inspiring Others***

A Case Study -- January 1970

A Case Study -- July 1970

JUL • 70

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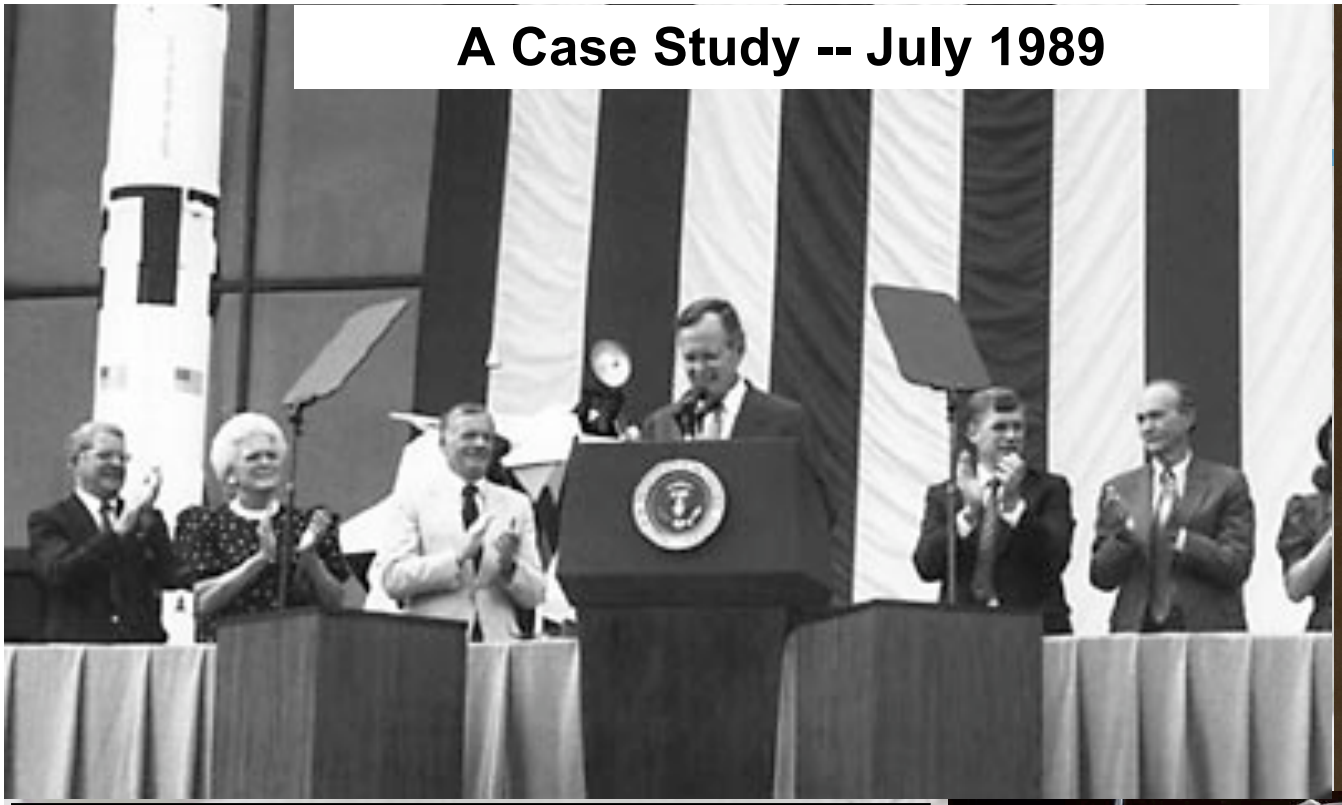
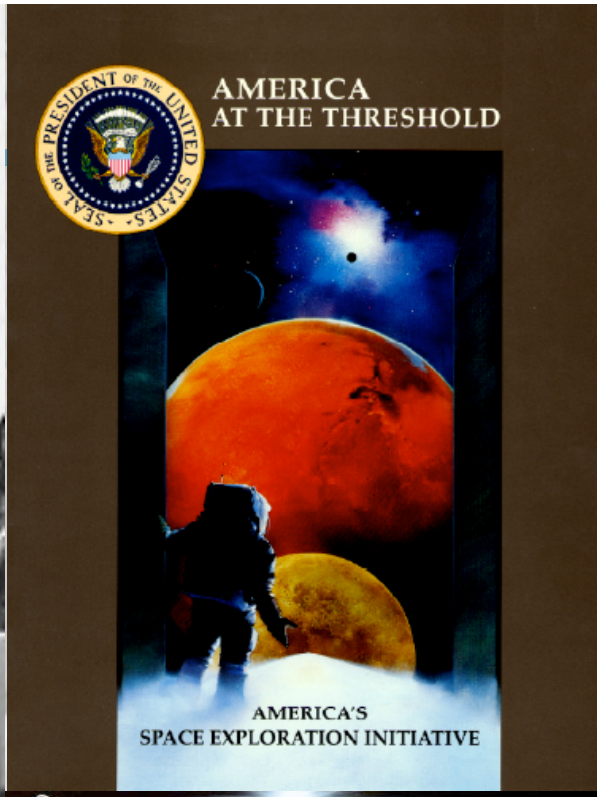
A Case Study -- July 1970

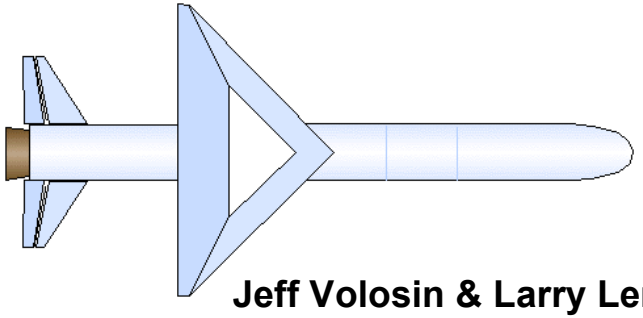
A Case Study -- July 1989



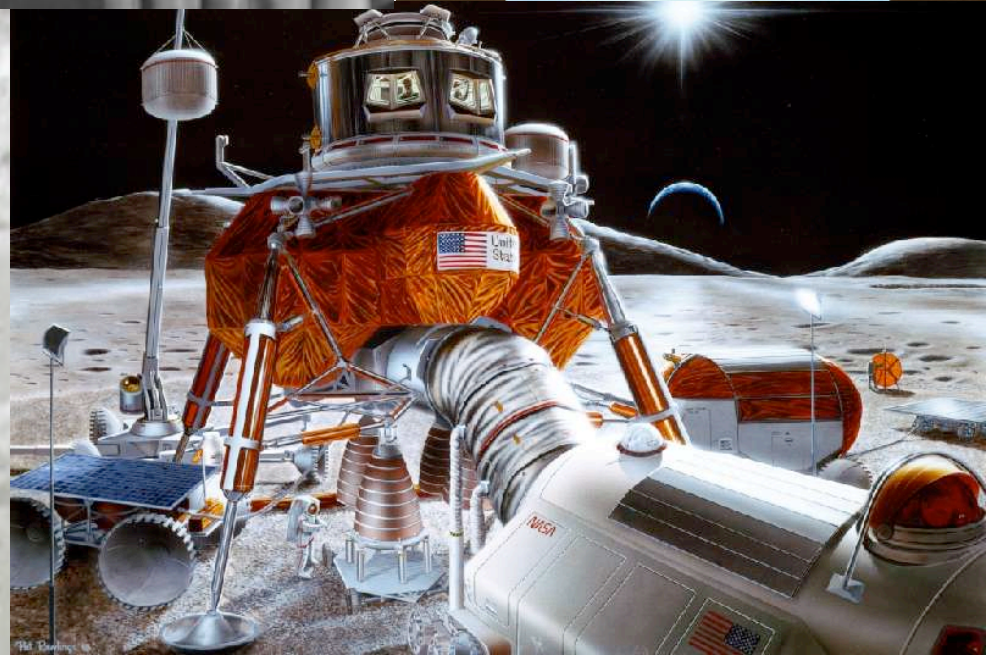


S.O.L.O

Single Occupant to Low-earth Orbit



Jeff Volosin & Larry Lemke
Budding Space Geeks



Dawn of a New Space Age: Developing a Global Exploration Strategy

The Real Presentation

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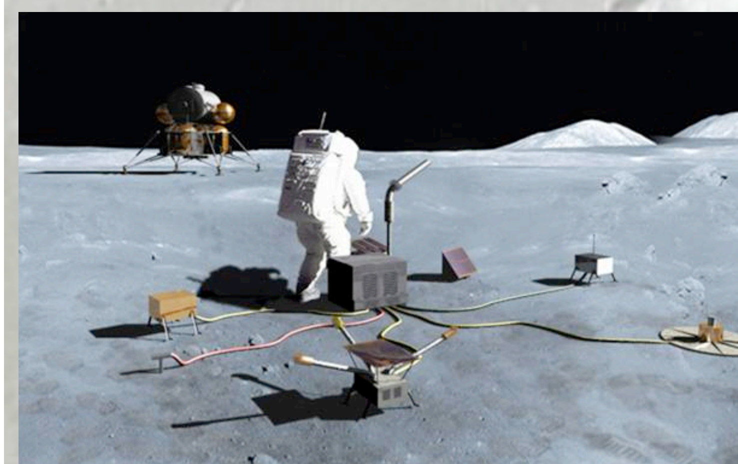
A Bold Vision for Space Exploration, Authorized by Congress

- Complete the International Space Station
- Safely fly the Space Shuttle until 2010
- Develop and fly the Crew Exploration Vehicle no later than 2014 (goal of 2012)
- Return to the Moon no later than 2020
- Extend human presence across the solar system and beyond
- Implement a sustained and affordable human and robotic program
- Develop supporting innovative technologies, knowledge, and infrastructures
- Promote international and commercial participation in exploration



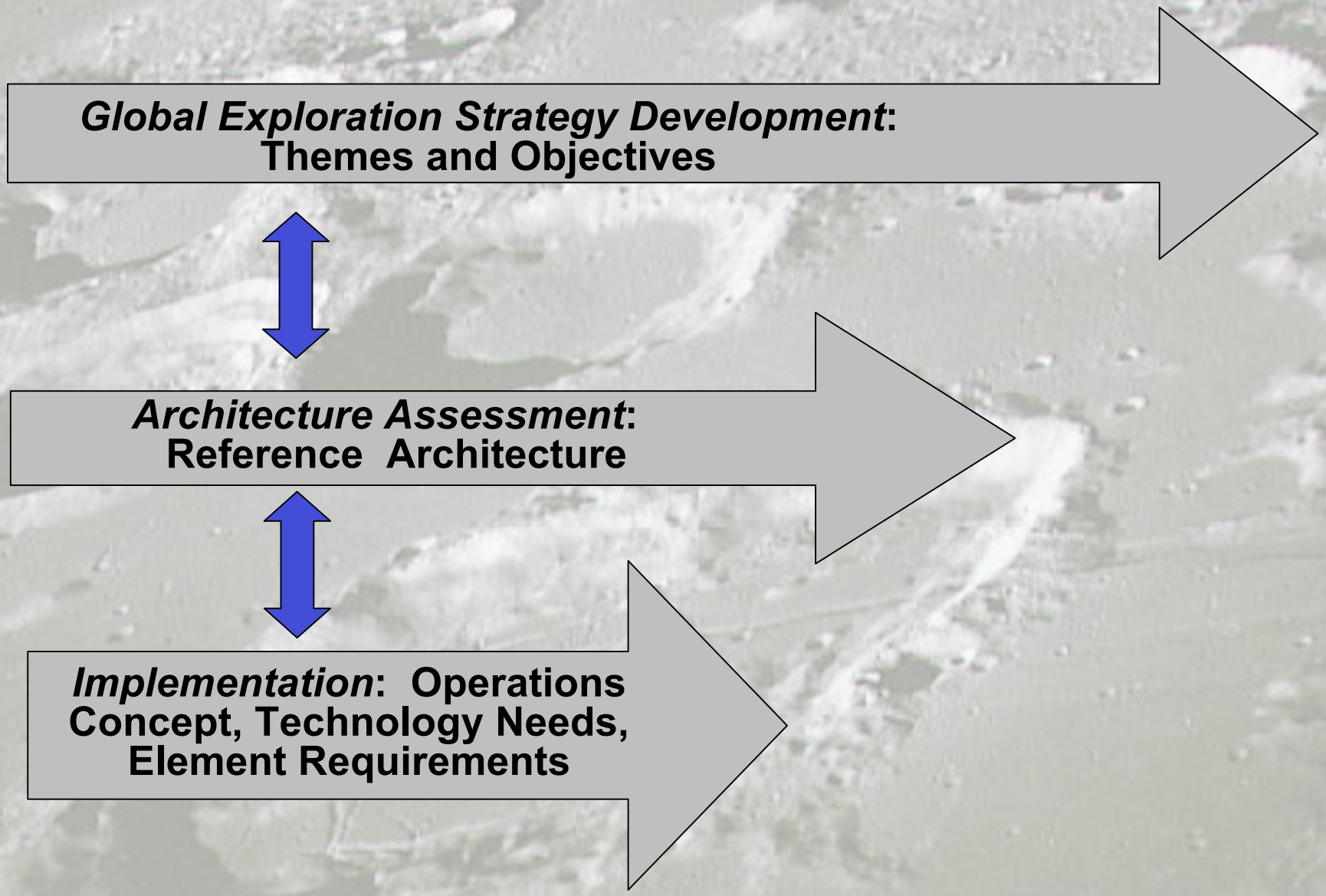
NASA Authorization Act of 2005

The Administrator shall establish a program to develop a sustained human presence on the Moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations.

"It is time for America to take the next steps. Today I announce a new plan to explore space and extend a human presence across our solar system. We … personnel. We'll make steady progress – one mission, …

President George W. Bush – January 14, 2004

Our Approach: An Architecture Driven By A Strategy



What is a 'Global Exploration Strategy'?

- **The compelling answer to the following questions:**
  - "Why" we are going back to the moon and
  - "What" we hope to accomplish when we get there
- **<u>Not</u> a definition of 'how' we will explore (operations & architecture)**
- **Global - refers to the inclusion of all stakeholders in the strategy development process - to ensure that as NASA moves forward in planning for future exploration missions - we understand the interests of:**
  - International Space Agencies
  - Academia
  - Commercial Investors
- **Includes the moon, Mars, and beyond as potential destination for exploration:**
  - Initially focused on human and robotic exploration of the moon
  - An evolving plan that will expand to include Mars and other destinations

What is a 'Global Exploration Strategy'?

- **A blueprint of exploration objectives that will serve as a starting point for:**
  - **Collaboration: discussions between participants regarding areas of potential collaboration**
  - **Coordination: coordination among participants to maximize what can be accomplished**
  - **Mission Design: detailed technical analyses that address,**
    - ***Time Phasing*** of activities and identification of dependencies between objectives
    - ***Prioritization*** based on inputs from various stakeholders
    - ***Operational and Architecture Impacts*** of implementation of the strategy

Components of Exploration Strategy

- **Themes: Address the question: Why should we return to the moon?**
- **Objectives: Address the question: What are we going to do when we get there?**

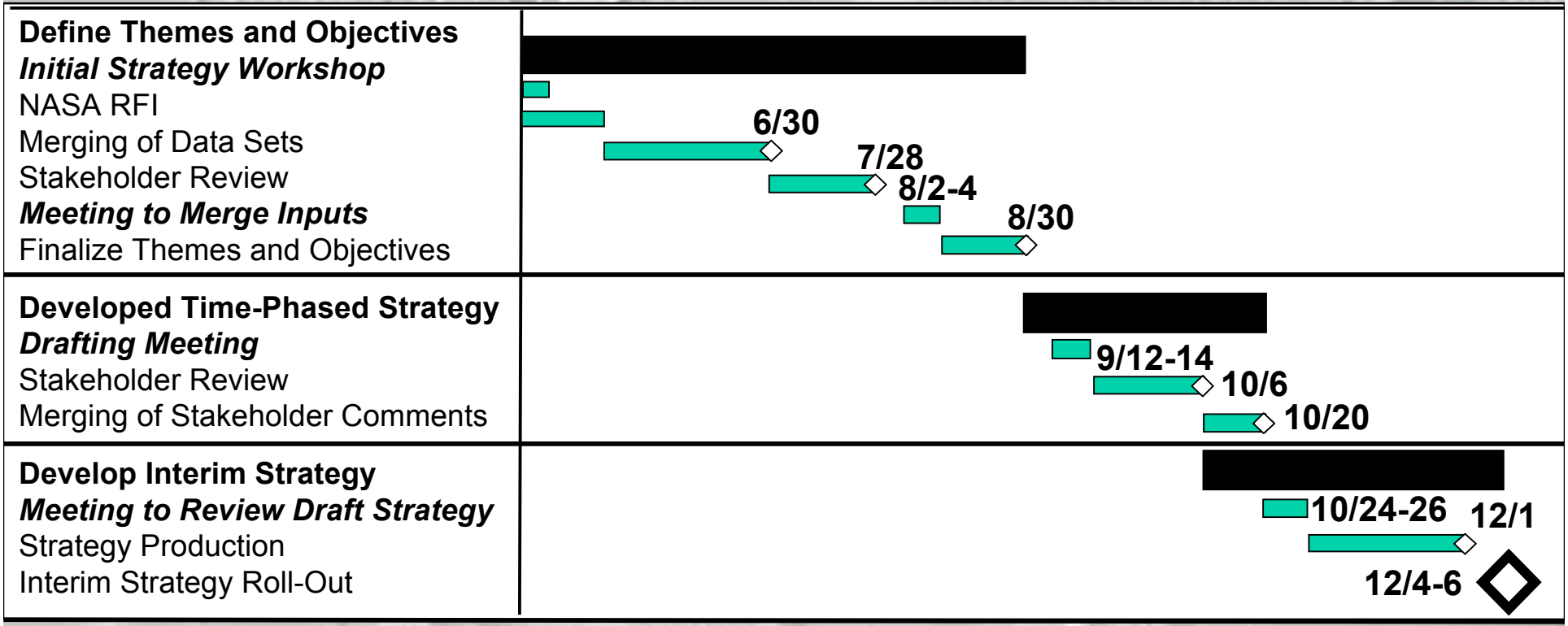
Components of Exploration Strategy

- **Themes**
  - **Provide the high level rationale for exploring the Moon**
  - **Provide a framework for capturing the many objectives across multiple disciplines**
  - **Divided into two types – core and crosscutting**
    - **Core themes address the primary reasons for conducting activities on the Moon**
    - **Crosscutting themes address ways to maximize the benefit of the core themes**

Components of Exploration Strategy

- **Objectives**
  - **Describe the discrete set of activities that the global community has defined as important in supporting the exploration themes**
  - **For example, the theme of using lunar exploration to prepare for future human missions to more distant destinations can be described by a set of associated objectives, such as scientific measurements, mission simulations, and technology and operations validation.**
  - **Serve as a means for breaking down the theme areas into achievable parcels of work that can be time-phased and prioritized – while still being at a strategic level**

Global Exploration Strategy Development Process for 2006



2006 Products

- **NASA developed video and brochure that address the two basic questions - "Why" and "What"**
- **Internationally developed *"Strategic Framework for Sustainable Global Space Exploration"* to establish a framework for future coordination and collaboration**

Current Draft: Overarching Themes

The following three Core Themes **address the primary activities to be conducted on the Moon:**

- **Use the Moon to prepare for future human and robotic missions to Mars and other destinations**
- **Pursue scientific activities to address fundamental questions about the solar system, the universe, and our place in them**
- **Extend sustained human presence to the Moon to enable eventual settlement**

Current Draft: Overarching Themes

The following three Crosscutting Themes **address ways to maximize the benefit of the core themes:**

- **Expand Earth's economic sphere to encompass the Moon and pursue lunar activities with direct benefits to life on Earth**
- **Strengthen existing and create new global partnerships**
- **Engage, inspire, and educate the public**

Current Draft
Exploration Strategy Objectives

Objectives collected from the workshop and RFI were grouped into 23 categories:

1. Astronomy & Astrophysics
2. Earth Observation
3. Geology
4. Materials Science
5. Human Health
6. Environmental Characterization
7. Operational Support
8. Life Support & Habitat
9. Environmental Hazard Mitigation
10. Power
11. Communication
12. Guidance, Navigation & Control
13. Surface Mobility
14. Transportation
15. Operational Environmental Monitoring
16. General Infrastructure
17. Operations Test & Verification
18. Lunar Resource Utilization
19. Historic Preservation
20. Development of Lunar Commerce
21. Global Partnership
22. Public Engagement
23. Program Execution

Current Draft
Exploration Strategy Objectives (Example)

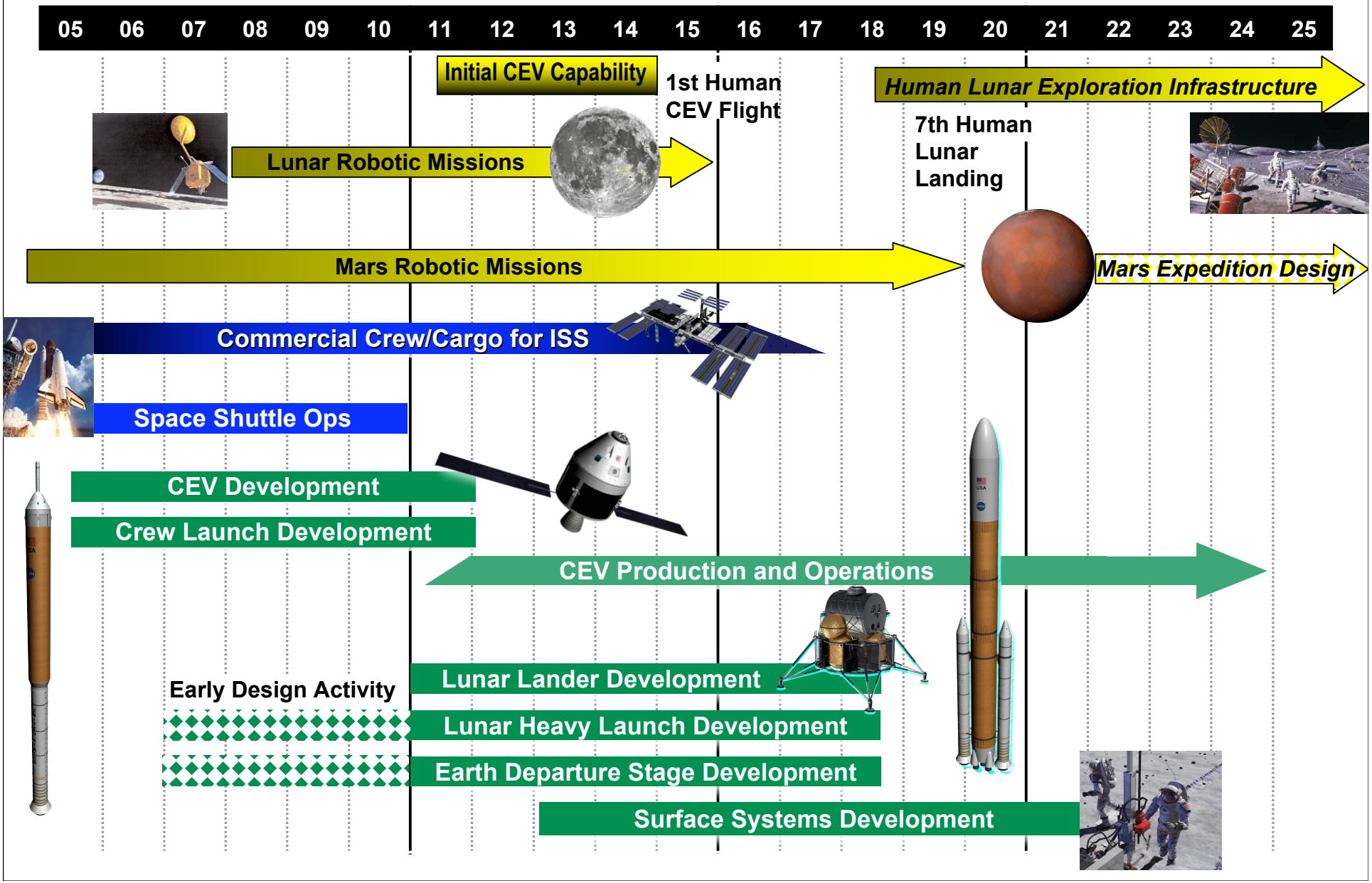
Geology

- **Objective: Determine the diversity of crustal rocks to better understand planetary differentiation processes**
  - **Value: The Moon presents the best opportunity to geochemically characterize early fundamental processes of a planetary body of substantial size. Much of the first billion years of planetary geochemical evolution is not available on Earth. In this regard the Moon and Earth represent end-member bodies in that the Moon reveals early geochemical processes, whereas the Earth is a continually active planet. Mars probably represents an intermediate case**

Using Strategy to Drive Architecture Design: NASA's Lunar Architecture Study

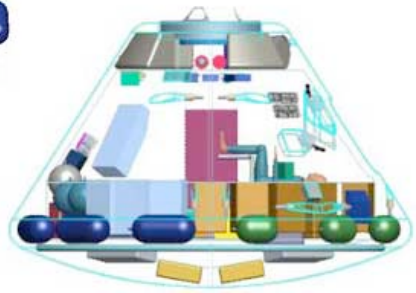
- **Study Objectives**
  - Define a series of lunar missions constituting NASA's lunar campaign to fulfill the Lunar Exploration elements of the Vision for Space Exploration
    - Multiple human and robotic missions
  - Develop process for future Architecture updates
  - Drive architecture studies from exploration strategy objectives
- **Two Phase Process**
  - Phase I (Initial Internal NASA Studies)
    - Understand architecture and operational impacts associated with the implementation of the key objectives that NASA is interested in achieving based on the Vision
  - Phase II (Maturation and Discussion With International Space Agencies)
    - Provide sufficient definition and supporting rationale for near term missions to enable commitment to these missions
    - Define areas of potential coordination and collaboration

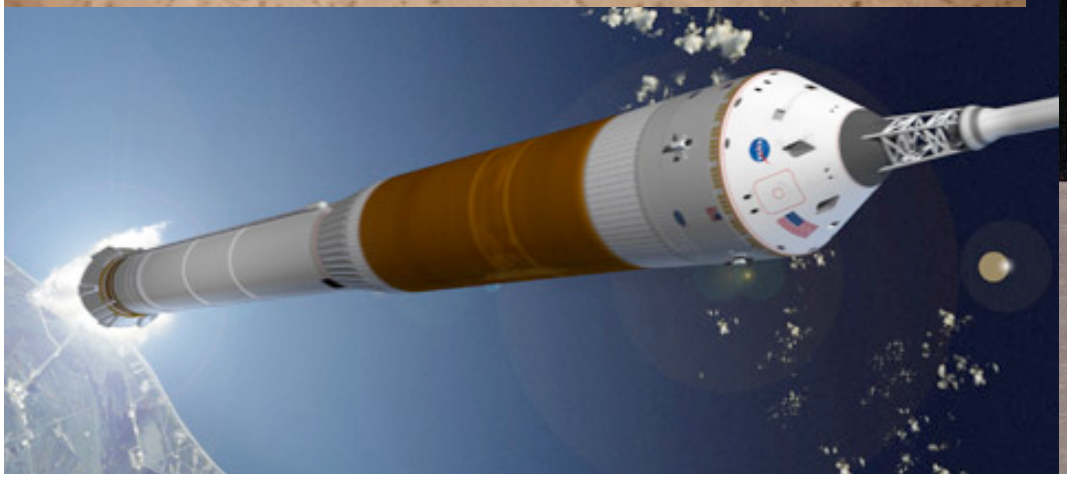
Using an Overarching Architecture to Drive Element/Operations Requirements

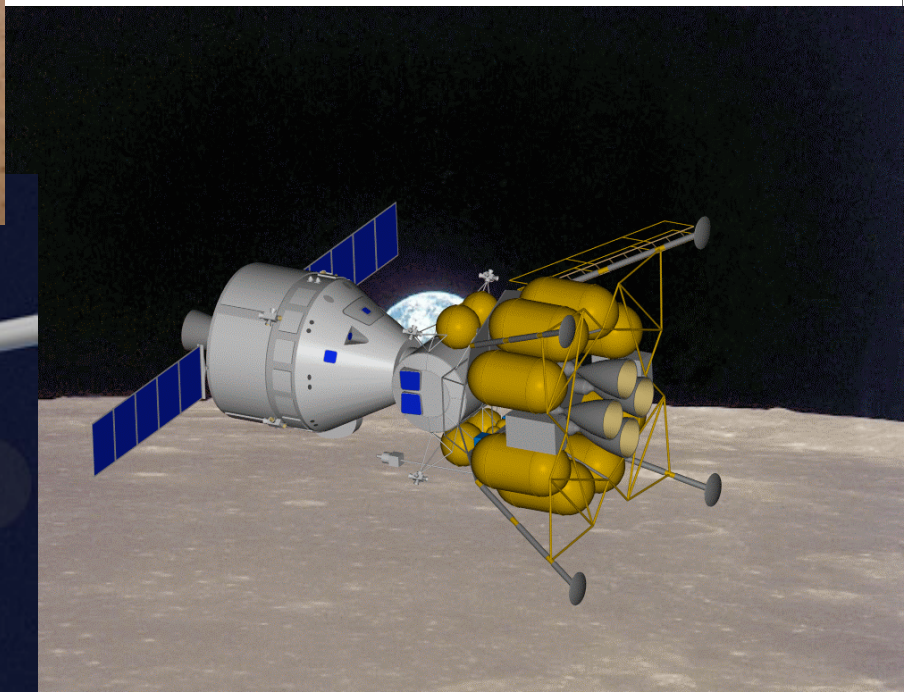


Looking Beyond the Shuttle - Focus on Ensuring Crew Safety During Transition In/Out of Earth's Atmosphere

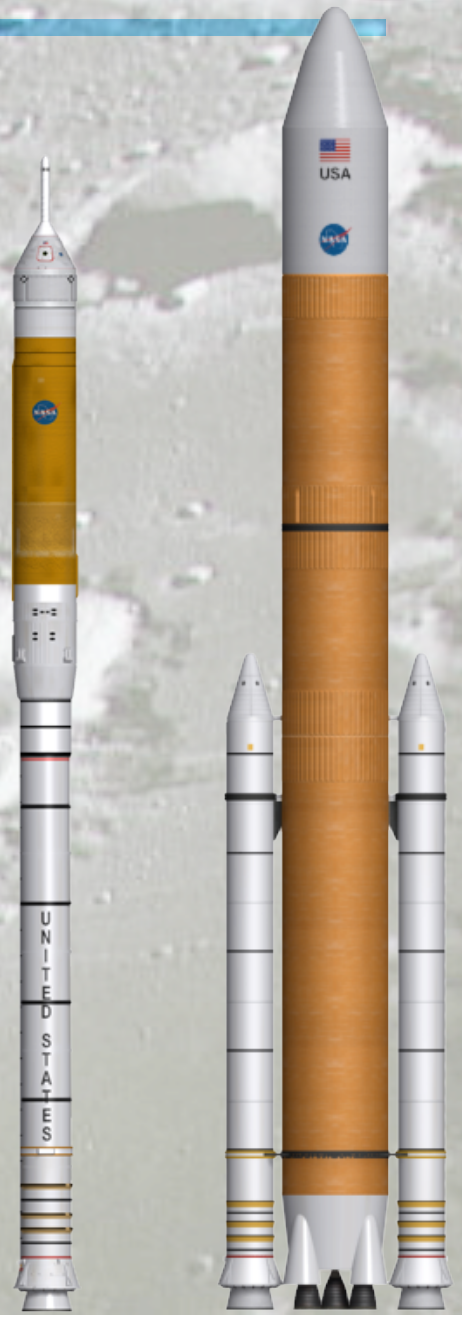
Crew Exploration Vehicle (CEV)





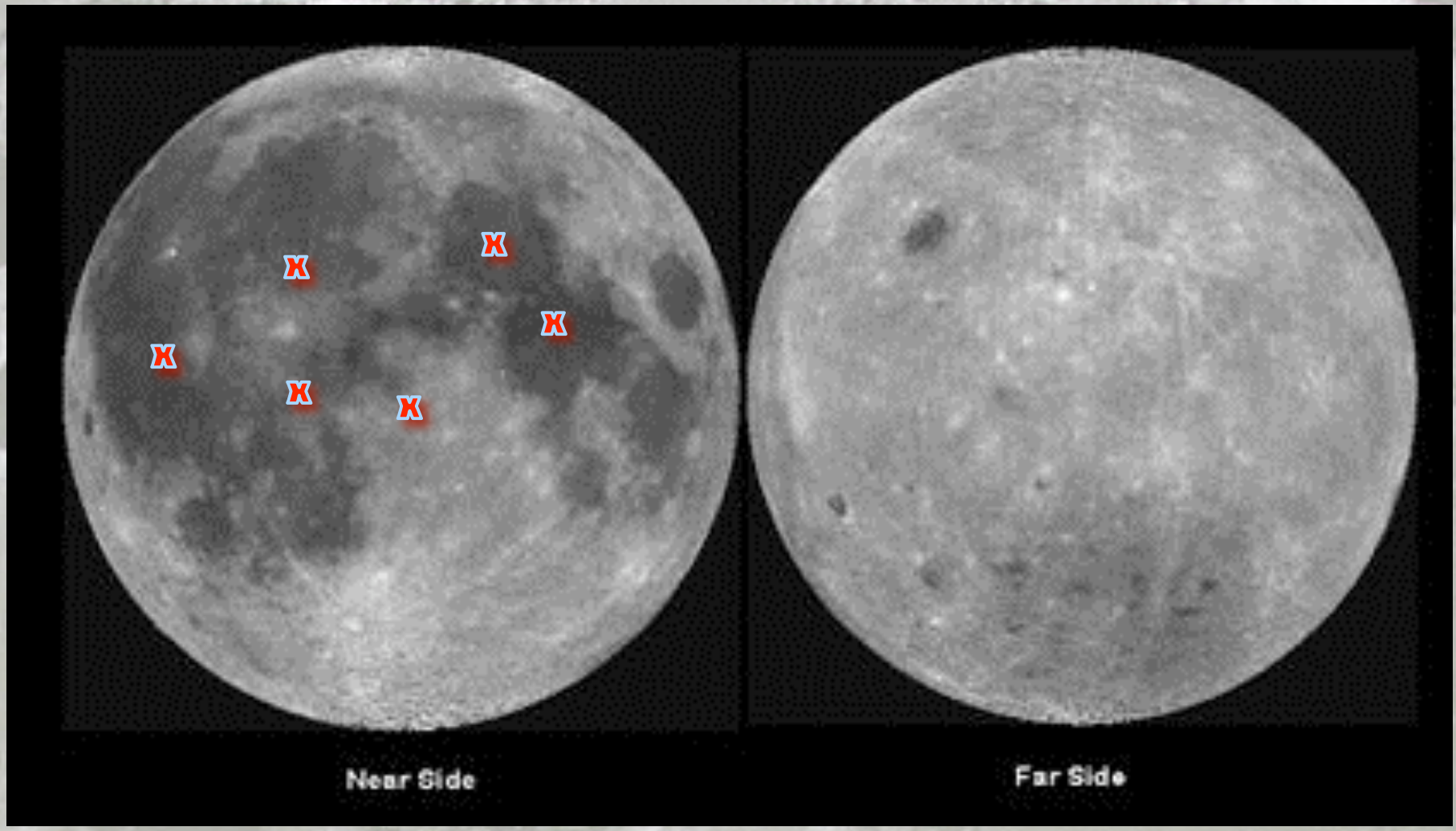


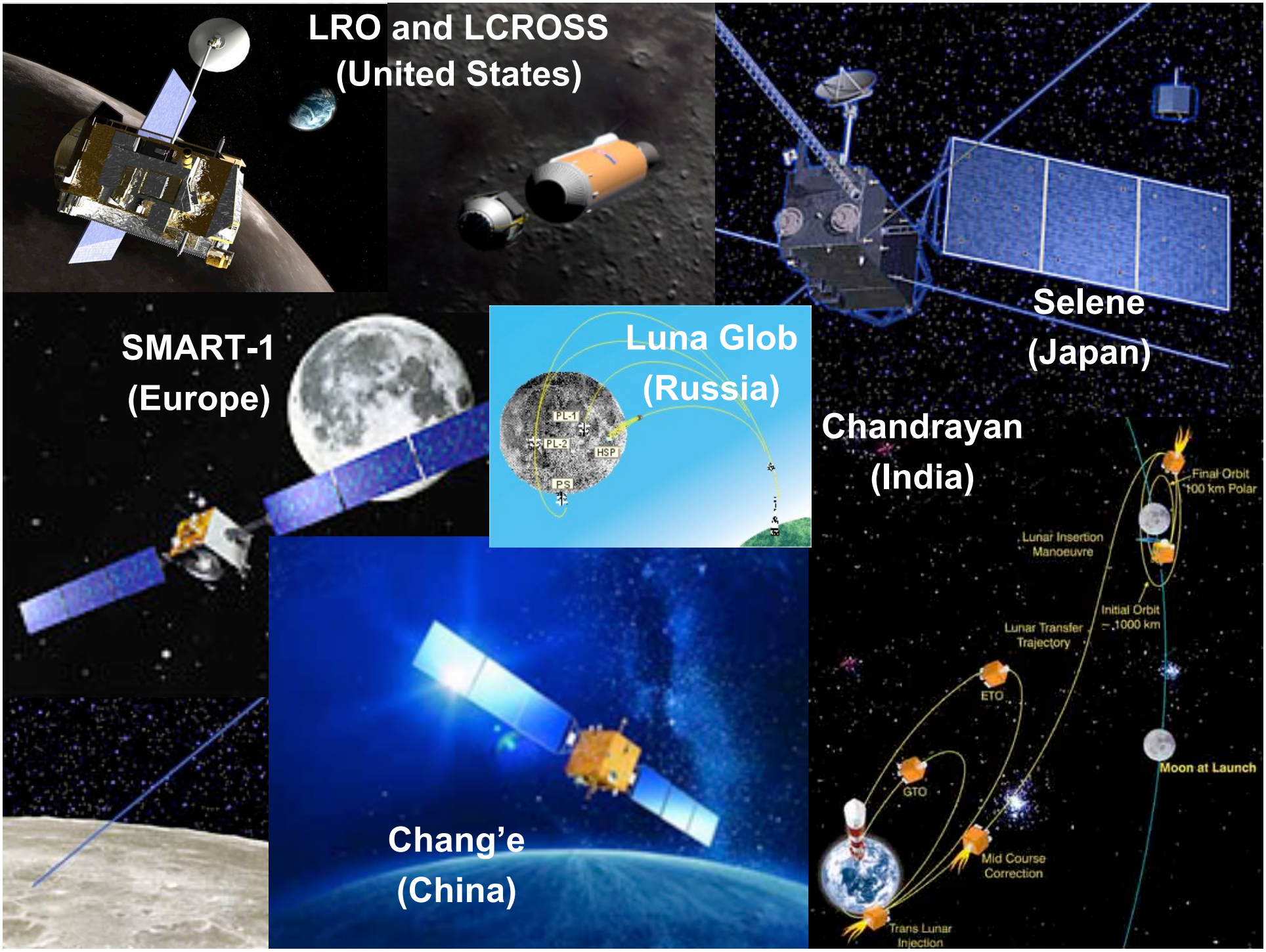
Designing Launch Vehicles for the Long-Haul



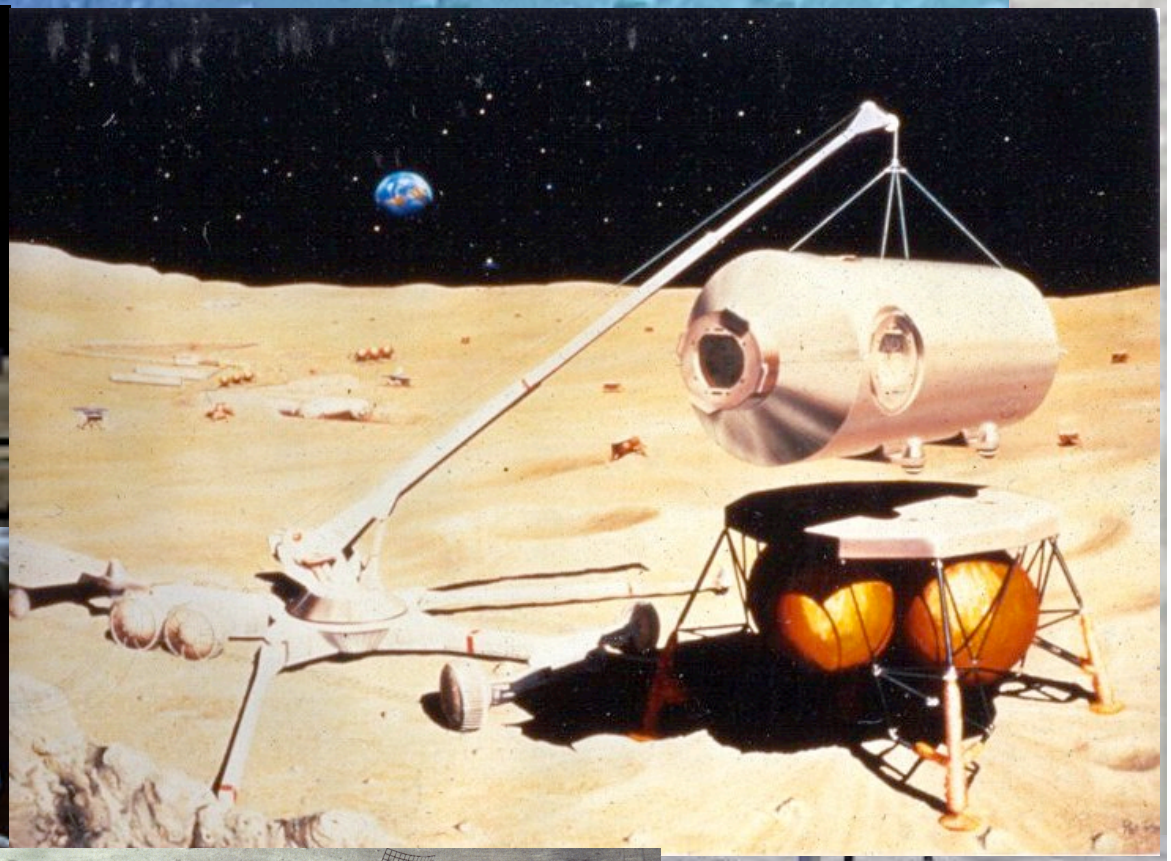
- *Near-Term: ISS Support*
- *Long-Term: Human Moon & Mars Exploration Support*

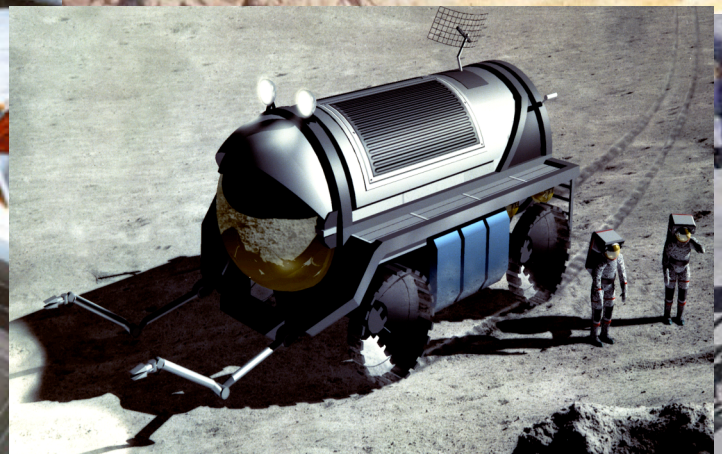
Where Will We Go When We Return?
Many Exciting Places Remain to Visit




LRO and LCROSS
(United States)
Selene
(Japan)
SMART-1
(Europe)
Luna Glob
(Russia)
PL-1
PL-2
HSP
PS
Chandrayan
(India)
Final Orbit
100 km Polar
Lunar Insertion
Manoeuvre
Initial Orbit
~1000 km
Lunar Transfer
Trajectory
ETO
GTO
Mid Course
Correction
Trans Lunar
Injection
Moon at Launch
Chang'e
(China)

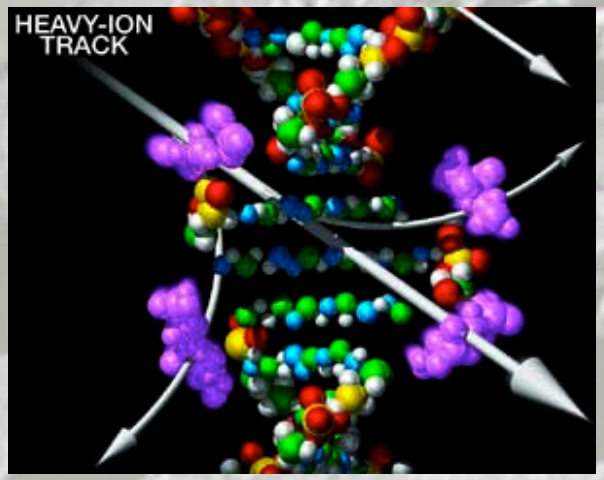
Studying What We Will Do On The Surface - Understanding The Design Requirements For Surface Landers and Equipment



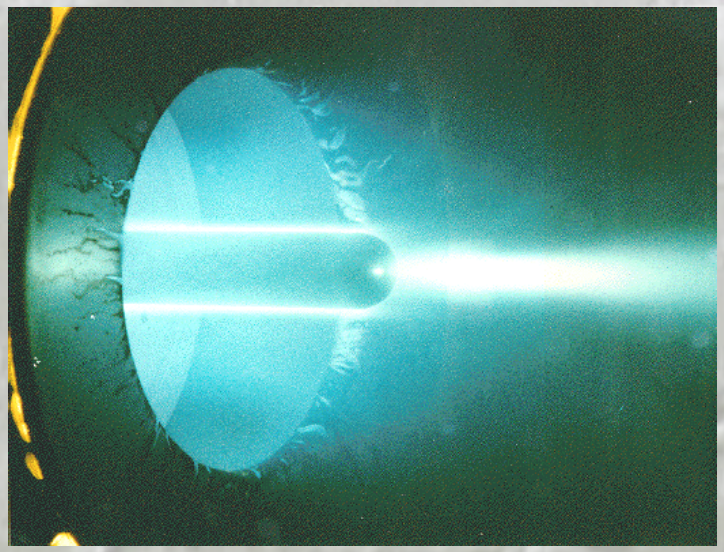


Building the Future Will Involve More Then Just Exploring The Lunar Surface

Human Research



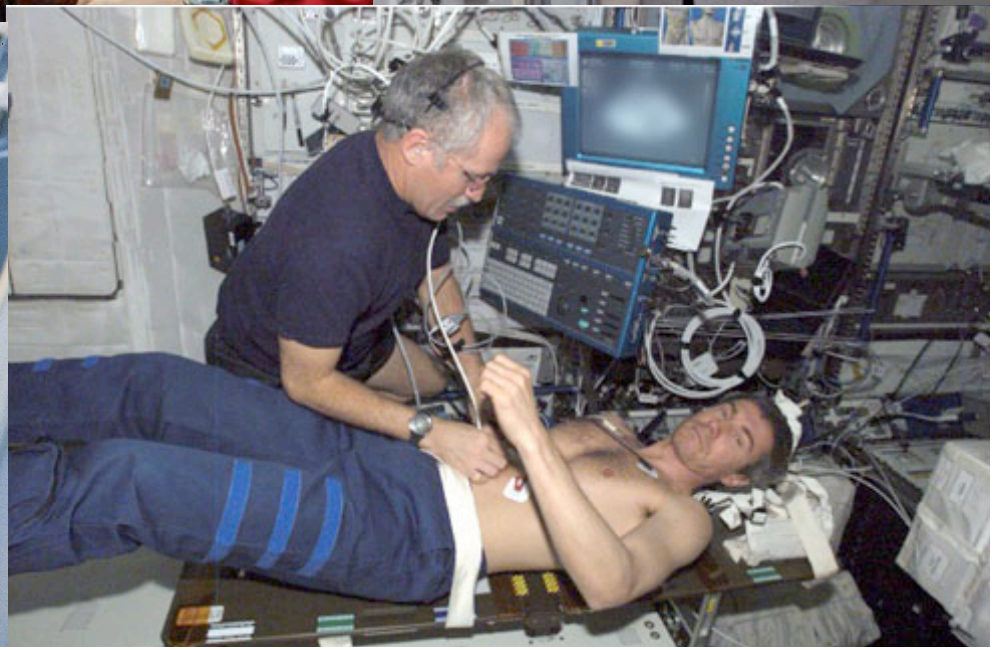
Technology Development



Why Do We Explore Space?

To Benefit Mankind Through

- **Discovery**
- **Invention**
- **Expansion of Our Horizons**
- **Inspiration**



Well - What Might the Distance Future Look Like?
There Are Many Different Possibilities